determination, and it is surprising how bad a condition may be removed, and *perfect recovery of outline* and of function attained by these means alone." [The italics are mine.] I have used for years, and still continue to use Mr. Ellis's exercises in the treatment of flat-foot, and have pleasure in bearing witness to their value as a means of removing pain and weakness, but as for *recovery of outline*, all I have observed leads me to congratulate the people of Gloucester on the supernatural patience and determination" they must possess if Mr. Ellis's impressions are correct.

One word more with regard to all appliances for the treatment of affections of the toes. The impossibility of getting the boot ordinarily worn by the patient, to contain them, makes him often disinclined to wear them until a stage has been reached in which mere appliances are scarcely enough to cure him. C. B. KEETLEY.

WITZEL ON INJURIES OF TENDONS AND THEIR TREATMENT.

A very complete study of the injuries of tendons and their proper treatment has been made by Dr. Oscar Witzel,[1] and we give a brief résumé of his views. The greater part of injuries of tendons are complicated with wounds, and yet isolated cases of subcutaneous rupture of tendons do occur. Witzel thinks that there is always some pathological change in the tendon in these cases. A previous tendo-synovitis may cause the infiltration of the tendon with serum, the tendon may be partly worn and ravelled in hydrops of the sheath, or reduced to a third or a quarter of its diameter in hydrops with lipomatous degeneration of the sheath.

The actual rupture may be caused by vigorous muscular action, but it is probably more frequently due to over-extension of the tendon and its usually weakened muscle. Hence in every case of sprain of a joint the examination should be sufficiently thorough to exclude this injury. The situation of the rupture can be detected by the finger, feeling the step-like gap between the ends of the tendon, as after tenotomy, the interval being filled with a soft clot of blood, which may give a crackling sensation to the finger. The chief symptom will be loss of function in the muscle the tendon of which is ruptured. If the ends can be brought into close contact, and care is taken during the treatment that they remain in apposition, union may be confidently expected. If the ends cannot be approximated by manipulation of the limb, incision and suture are indicated, as in fracture of the patella and olecranon. But it will be best to delay the operation until the first inflammatory reaction has passed, so as to avoid the presence of blood, so easily made septic in the sheath of the tendon.

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[1] Ueber Sehnenverletzungen und ihre Behandlung, Volkmann's Sammlung klin. Vortraege No. 291.

One feature common to nearly all wounds with injury of tendons, is that they are directed more or less transverse to the axis of the limb and to the course of the tendon. The character of the instrument is of great importance, for clean-cut wounds heal much more rapidly than wounds with contused and lacerated edges, but the most important element is the presence or absence of septic matter.

The prognosis is very uncertain, and chiefly depends upon the condition of the wound with regard to sepsis at the time when it first comes under treatment.

Secondary necrosis of parts of the tendon may follow if suppuration takes place, but this is much less likely to occur, or at least to be extensive, if the suppuration is not septic. As it is impossible to determine how septic the wound may be, if there is any doubt upon this point, the wound should be left open, since the amount of injury caused by the suppuration will be diminished by allowing free escape to the discharge. This must also be done if the tendon has suffered much contusion. Suture of the tendon cannot be attempted in these cases, but an operation for suture can be done later, when the wound is granulating well, and all septic infection has disappeared (intermediate suture), or when the wound has entirely cicatrized (secondary suture).

That extensive exposure and isolation of a tendon in a wound will be followed by its mortification, is an old teaching. But if the wound is aseptic, gangrene will not occur so long as the nourishing covering of the tendon remains, and the blood-supply is maintained. If the blood-supply is cut off, the isolated part dries up, turns gray, and is thrown off by granulation at the edges.

Simple division of a tendon by incision is a small matter, for experience teaches that the divided ends rapidly unite if kept in contact, uniting by first intention like other tissues. The material for this union appears to be supplied rather by the sheath than by the tissue of the tendon, and the two ends are joined by a mass of callus (like a fractured bone) which is at first adherent to the neighboring parts. These adhesions are separated by motion, and the exuberant callus wears off by friction, so that the point of union cannot be detected even by a longitudinal section of the tendon.

The great difficulty in injuries of tendons lies in the retraction of the divided ends—a separation which is greatest when the tendon lies in a long synovial canal. The two ends become adherent in this position of separation, and the muscle suffers atrophy from disuse; even if the ends are united by the interposition of new tissue, the muscle loses in power.

Whenever there is a possibility that tendons have been injured in a wound, especially upon the anterior surface of the hand and forearm, the action of every muscle should be examined. All the movements of the hand should be made, the fingers spread apart (loss of the power to separate the fingers indicating that the ulnar nerve has been injured), and the fingers flexed while separated, and due allowance made for the action of auxiliary muscles. The projection of the tendons under the skin must be looked for. Another reason for thorough examination of the action of the muscles in fresh injuries, is the great danger of overlooking some tendon when more than one have been injured.

In the examination of such wounds, as full antiseptic precautions must be employed as in the examination of a compound fracture. Anæsthesia and Esmarch's method are very useful, the former assisting as much by relaxation of the muscles as by prevention of pain.

By moving the limb in a direction opposite to that in which the affected muscle moves it, the retracted ends of the tendon can often be made to appear in the wound. Should this fail to bring the central end into sight, the muscle must be strongly compressed, and stroked downwards from its origin, towards the periphery, by the hands of a strong assistant or by the rubber bandage wound from above downwards. Some attempt to lay hold of the end of the tendon with forceps inserted into the sheath, but there is great danger of septic infection in this manœuvre, as well as danger of tearing or contusing the tendon. It is far better to enlarge the wound at once. But by the old method of enlarging the wound—cutting directly down upon the tendon, it was often difficult to unite the skin over the tensely stretched tendon after suture, and the tendon was liable to become firmly attached to the cicatrix. Witzel prefers to make an incision in the skin, beginning at the wound, to one side of tendon and parallel to it, and to dissect up a flap until the tendon is exposed. The sheath of the tendon is then opened, if possible, on the side. This method also affords an opportunity to thoroughly drain and disinfect the sheath, which has almost certainly been rendered septic by the retracting tendon.

The needles of Hagedorn are best for suturing tendons, because they separate the fibres without tearing them. But the same object can be attained with the fine needles curved on the flat employed in operating for hare-lip, if they are passed with their greatest diameter parallel with the fibres. The best material for sutures is the bichloride catgut of Hagedorn.

Any suture which is at all constricting will prevent union, by cutting off the blood-supply, hence Nicoladoni's suggestion to make the sutures of the most delicate material, and to relieve them of tension by passing an acupuncture needle, or a catgut suture through the tendon and the tissues overlying it, at a distance of one inch above the point of division, is excellent. Witzel has found it simpler to pass a medium sized catgut suture through each end of the tendon, one centimetre from the point of division, after they have been exposed in the wound, and to tie the ends of these sutures together after the true sutures have been inserted, so as to remove all tension from the latter. If the distal end is too short to allow of this suture, it is to be passed through the soft parts and skin, and the other suture secured to it.

The greater security afforded by these relaxing sutures enables the surgeon to make passive movements of the limb, and thus to place the sutured point so that it does not correspond with the wound; or, when more than one tendon has been injured, to arrange the points of suture of different tendons so that they do not lie in one place. It is well to place some strands for drainage under the flap, down to the point of suture, but not in contact with it.

If the wound is septic, the tendons can be sutured and the rest of the wound left open. But if there is doubt as to whether the sepsis can be entirely corrected, it will be better not to attempt even this. In such a case the method of Nicoladoni would be useful to prevent retraction of the ends—at any rate, the limb must be put at rest in such a position that there will as little retraction as possible. Whether intermediate suture, suture in the granulating wound when all signs of sepsis has disappeared, is advisable, remains for experience to prove—thus far the evidence is in its favor.

Secondary suture of tendons, the wound having completely cicatrized, may be begun with a rectangular or convex flap, the long side lying to one side of the tendon and parallel with it. The tendon must be very carefully dissected from the cicatrix with blunt instruments, so as to avoid subsequent sloughing. If there is cicatricial tissue filling the gap between the ends, this must be dissected out, and left attached to the tendon. The ends are then freshed and united with sutures.

But if the ends cannot be made to meet, some plastic operation becomes necessary. It is best to cut the flap to fill the interval from the peripheral end; but the central end may be used, and in one case an entirely isolated piece of tendon has been successfully grafted in. The experiments and cases of Glück show that even catgut, or silk, or strips of India rubber may be employed as grafts.

If even this is impossible, there remain, as last resorts, the implantation of the peripheral stump in the tendon of a neighboring muscle which has a similar action; its attachment to a less important muscle, the tendon of the latter being cut away; or the splitting of an uninjured tendon and muscle so as to form two, and using one to replace the muscle which has been lost.

The dressing must be left untouched as long as possible, and as soon as the drainage openings are all closed the fixation apparatus should be removed, so that voluntary motion may begin. Two weeks after the operation, massage is to be begun, and one week later, passive motion. If the course of the wound is not fully aseptic, and it becomes necessary to remove the dressing and re-open the wound, the sutures in the tendons should be left in place, unless it is absolutely necessary to cut them, as union has been known to occur even when slight suppuration was present. But in such cases motion can only be begun when the wound is closed or reduced to a superficial ulcer. If a plastic operation has been done, motion must not be undertaken until four weeks have elapsed. B. FARQUHAR CURTIS.

A NEW CLASSIFICATION OF TUMORS IN GENERAL AND OF TUMORS OF THE TESTICLE IN PARTICULAR.[1]

In a paper of considerable length, Messrs. Monod and Arthraud have developed a complete classification of tumors in general and of the seminal gland in particular in extension of the embryonic theory of Cohnheim. A brief review of the history of the various theories with regard to tumors being considered necessary, they pass rapidly over the earlier hypotheses, beginning with the heteromorphic theory of Laennec, formulated by Lebert and defended by Broca, who considered tumors as parasitic productions absolutely foreign to the constitution of the normal tissues. This was followed by Müller's doctrine of the heterotopia of neoplasms, which he considered to consist of the normal elements, their appearance being referable to a still unknown deviation of the normal evolution of the tissues. In his cellular pathology, Virchow attempted to show the processes employed by the organism to develop these morbid masses in the midst of healthy tissues. The dominant thought of Virchow was the substitution of the observation of present and transient forms of the diseased tissues by the study of the successive transformations which they may undergo;

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[1] Considerations sur la classification de tumeurs du testicule. Par le Dr. Ch. Monod et le Dr. G. Arthraud, de Paris, *Revue de chirurgie*, 10 Mars, 1887.